





possibility of such harm being caused, or (b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused".

Further details on how sites should be dealt with under Part 2A are provided in Statutory Guidance, which has recently been revised by DEFRA. A key aspect of the revised Statutory Guidance is that land should be placed in one of four categories, following assessment, principally based on risk. Therefore, different regimes now exist in England and Wales (which are subject to the new guidance), Scotland (which is not subject to the new guidance) and Northern Ireland (where Part 2A has never been implemented).

Under Part 2A, Local Authorities are responsible for the identification of contaminated land, using a risk-based approach, and for ensuring that remediation is undertaken, where necessary. Local Authorities must also maintain a public register detailing the regulatory actions that they have implemented. The Environment Agency has a complementary role, with specific responsibilities such as acting as the enforcing authority for designated special sites. As well as its regulatory role, the Environment Agency has published a great deal of technical guidance for local authorities and practitioners on how to assess and remediate potentially contaminated sites.

## Local Authority Planning System

Contaminated land is also a consideration within the Local Authority planning system. When planning permission is sought for the development of a site that is potentially contaminated, the local planning authority will take this into account and may require investigative work (and possibly remediation) to be completed by the applicant.

Developers (applicants) often commission specialist environmental consultants to conduct contaminated land investigations on their behalf. The resulting assessment can then be submitted with the planning application to the Local Authority for approval, assuming that the site is suitable for its proposed use. Although planning permission may be granted on condition that a site is investigated and remediated to the satisfaction of the Local Authority, such work may also be performed prior to submission. The National Planning Policy Framework (NPPF) provides further details on this, as do local planning policy documents (where available).

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"conceptual model" is also developed during this stage and a qualitative judgement made concerning the need for further assessment, based on the likely completeness/significance of such linkages.

Where the PRA identifies potentially significant source-pathway-receptor linkages, an intrusive investigation may be carried out to provide quantitative information on contaminant levels at the site, to help assess pathways and risk to receptors as part of a Generic Quantitative Risk Assessment (GQRA). Such an investigation typically involves obtaining soil and/or groundwater samples, via drilling and/or ground excavation, and submitting them for chemical analysis. Reported contaminant concentrations in soil and groundwater are then compared with available Generic Assessment Criteria (GACs) using statistical techniques, if appropriate. If concentrations are particularly elevated then a Detailed Quantitative Risk Assessment (DQRA) can be performed and/or the site identified for remediation. A DQRA may involve the use of computer models to derive Site Specific Assessment Criteria (SSACs), for further comparison with contaminant concentrations, as well as additional investigative activities (e.g., media sampling, bioaccessibility testing, measurement of plant uptake).

As indicated above, a GQRA often involves the comparison of GACs against measured contaminant concentrations in soil. GACs for certain substances have been published by Defra/Environment Agency, in the form of Soil Guideline Values (SGVs), which represent "minimal risk" while other organisations have used the same Contaminated Land Exposure Assessment (CLEA) model used to derive the SGVs, to derive values for other substances. The CLEA model software can also be used by risk assessors to derive SSAC values, as part of a DQRA.

In relation to the assessment of potential risks to groundwater, the Environment Agency's "Remedial Targets Methodology; Hydrogeological Risk Assessment for Land Contamination" can be used. The methodology involves increasingly complex equations to derive remedial targets in soil and groundwater. The remedial target is based on reducing the soil and/or groundwater concentrations at the contamination source to a concentration that does not pose an unacceptable risk to receptors.

## Remediation

If the results of the GQRA or DQRA indicate that contaminant concentrations pose a significant, or unacceptable risk to critical receptors, the risk evaluation step which follows is likely to identify a need for remediation. The risk evaluation is based on the results of the risk assessment as well as other considerations, such as cost-benefit considerations.

Account has to be taken of the practicability, durability and effectiveness of remediation options, and whether remediation is reasonable given the likely cost and the seriousness of the harm or pollution. In general, remediation requires assessment, remedial treatment, and monitoring. Remedial activities may require planning permission and/or other environmental permits.

Remediation may involve:

- Contaminant removal, destruction or conversion to less mobile or toxic form;
- Blocking the pathway between the source and receptors;
- Changing the receptor, e.g. from residential to commercial land use.

The degree of remediation required for an area of contaminated land is primarily dependent on its intended use. In practice this means that, for example, a site to be redeveloped as a car park would require less stringent



Remediation treatment technologies can be applied either ex-situ (excavation of soil followed by treatment) or in-situ. Some examples of remedial treatments are outlined below:

### Ex-situ bioremediation

Windrow turning (a term borrowed from a composting technique in agriculture) involves the mechanical excavation of contaminated soil and placement into thick layers or heaps. Regular mechanical turning and tilling of the heaps is then carried out to improve the aeration of the soil. Naturally occurring micro-organisms in the soil facilitate biodegradation of the contaminants and thereby reduce the concentrations to a site-specific remedial threshold.





## Conclusions

The UK, along with other industrialised nations, has suffered a legacy of soil and groundwater pollution. Current UK legislation and statutory guidance forms a positive framework for the management of contaminated sites, based on the concepts of risk assessment. The risk-based management of potentially contaminated land through inspection, assessment and remediation is a complex process. Chemists have a vital role to play in all stages of this process, alongside other relevant specialisms.

## Further Reading

BS10175:2011. Investigation of potentially contaminated sites – Code of Practice. British Standards Institution, London. 2011. Available from: <https://www.britishstandard.org.uk/pub/bs-101752011--investigation-of-potentially-contaminated-sites.-code-of-practice-9780580681981.aspx>

Contaminated Land Remediation. Defra Research Project SP1001. Final Report. 2011. Available from: <http://randd.defra.gov.uk/>

Environmental Protection Act 1990: Part 2A. Contaminated Land Statutory Guidance. Defra, April 2012. Available from: <https://www.gov.uk/government/publications/contaminated-land-statutory-guidance>

Human health toxicological assessment of contaminants in soil, SC050021/SR2, Environment Agency, August 2008. Available from: <https://www.gov.uk/government/publications/human-health-toxicological-assessment-of-contaminants-in-soil>

Land contamination risk management (LCRM) webpages, October 2020. Available from: <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

Remedial Targets O/F1 11 Tf1 0 0 1 435.1hsessmdt/



## Relevant organisations

Defra <http://www.defra.gov.uk>

Scottish Government <http://www.scotland.gov.uk>

Environment Agency <http://www.environment-agency.gov.uk>

Natural Resources Wales [Natural Resouev.uk](http://www.naturalresources.gov.uk)